

SOME NEW BOOK

supported by reference to the existing differences between the climates of the northern and southern hemispheres, and by what is known to have occurred during the last glacial epoch; and it is shown to be in harmony with the geological evidence as to interglacial mild periods.

Discussing next the evidence for glacial epochs, in earlier times, the author shows that Dr. Croll's views are opposed by a vast body of facts, and that the geological evidence irretrievably prompts the inference that during a large part of the secondary and tertiary periods the world was untroubled by the ice which now covers the north temperate zone, and so far removed from the climate of the arctic regions as to admit of the growth of a luxuriant vegetation in the highest latitudes yet explored. The geographical condition of the northern hemisphere at those periods is then investigated, and it is shown that the warm waters of the tropics were free to penetrate the iceless seas to reach the arctic seas by several routes; and, adopting Dr. Croll's views as to the enormous quantity of heat that would thus be conveyed northward, it is maintained by the author that the mild arctic climates of certain eras are amply accounted for. We are then brought to the geographical condition of the sea around

changes of the earth's eccentricity, and in the phases of precession, would have no other effect than to cause greater differences of temperature between summer and winter. The amount of ice there was, a considerable extent of ice left, and the snow line would be lowered, and the snow collecting area being thus largely increased, a considerable amount of glaciation might ensue. Thus might be explained the presence of enormous ice-borne rocks, in coasts and midocean, and the fact that the ice was there very some period, all the surrounding country enjoyed a tropical or sub-tropical climate.

The general outcome of Mr. Wallace's researches and speculations in this specification is that geographical conditions are the cause of the present distribution of land and sea and that the radically different distribution of land and sea in the northern and southern hemispheres has generally led to great diversity of climate in the arctic and antarctic regions. The form and arrangement of the continents and the transfer of the warm oceanic currents to the north, the absence of those which move toward the south-

and whenever these currents had free passage through the northern land masses to the polar area, a mild climate must have prevailed over the whole northern hemisphere. It is only in the present day that the northern hemisphere continents have become so completely consolidated as they now are, thus shutting out the warm water from their interiors, and rendering possible a widespread and intense glacial epoch, such as that which we are now endeavouring to change was actually brought about by the eccentricity which occurred about 200,000 years ago, when, as astronomers calculate, the difference between the distances of the earth from the sun in aphelion and perihelion had increased to ten and a quarter of the present half millions of miles. Mr. Waller thinks it is not an unlikely supposition that a similar glaciation in equally low latitudes could be produced by means of any such geographical combinations as are now presented on the earth's surface without the concurrence of a correspondingly high eccentricity. It is in fact a very reasonable view of the present condition of the earth supports this view; for though we have enormous mountain ranges in every latitude, there is at present no glaciated country south of Greenland in N. lat. 60°. But directly we go back a very few millions of years, we find that the ice of glaciation, to an enormous extent over three-fourths of the globe, in the Alps and Pyrenees, in the British Isles and Scandinavia, in Spain and the Atlas, in the Caucasus and the Him-

Alaya, in Eastern North America and west to the Rocky Mountains, in the Andes, in its mountains in Brazil, in the Himalayas, in New Zealand, huge moraines and other unmistakable ice marks attest the universal descent of the snow line for several thousand feet below its present level. Mr. Wallace insists that we reject the influence of high eccentricity in this case, and admit universal glaciation. We must postulate a general lowering of the snow line about the same time, for these mountains about the same time, for the close similarity in the state of preservation of the ice marks and the known activity of denudation as a destroying agent forbid the idea that they belong to different periods. The only hypothesis suggested by the denudation alone has lowered the mountains much during the quaternary epoch, that we were previously of sufficient height to account for the glaciation of all of them. But this in our author's judgment hardly needs refutation. It is clear, he thinks, that denudation could not, at all times, have lowered the snow line to several feet or even to many hundreds of square miles of lofty snow-collecting plateaus and yet have left moraines and blocks, and even glacial stria undisturbed and undefaced on the slopes and in the valleys of these same mountains.

On the course of the earth, Mr. Wallace's geological climate set forth in Mr. Wallace's volume, while founded on Dr. Croll's researches, differs from all that have yet been made public in clearly tracing out the comparative influence of geographical and astronomi-

of revolutions—in showing that while the present position of the chief, if not the exclusive cause of the present distribution of the arctic regions, the concurrence of the latter has been essential to the predominance of glacial epochs in the temperate zones, as well as of those local glaciations in low latitudes of which there is such an abundance of evidence. It would seem that the late Wallace is more than justified in his commend itself to geologists, since it affirms the direct dependence of climate on physical processes, guided and modified by those very changes in the earth's surface which geology alone can trace out. It is in manifest accord with the most recent teachings of geological science as to the nature of progressive climatic changes of the earth's crust, and the glacial formations of the zoogeography, and it lends support to the view that no important departure from the great trunk lines of elevation and depression originally marked out on the earth's surface have ever taken place. It also shows that the importance of an agent in the formation of a habitat is not confined to the relatively small extremes of climates over the whole area; the great disproportion between the extent of the land and the water surfaces. We are thus led to see that what are usually regarded as geographical anomalies—the disproportion of land and water, the gathering of the land into a few great masses, the general arrangement of the land in three great southward-pointing masses—are really facts of the greatest significance, since it is to these very anomalies

that the universal spread of vegetation and the adaptability of so large a portion of the earth's surface for human habitation are the result of the action of the laws of nature. As the late Mr. Wallace has just ably and judiciously introduced Mr. Wallace to a final difficulty, which he hitherto been considered a very formidable one, namely, that the maximum age of the habitable earth, as deduced from physical considerations, does not afford sufficient time since the origin of the earth for the gradual accumulation of the various elements, fossils, and plants which have evidently accumulated, it will be remembered, continually lived on the surface of the globe, the process of upheaval and subsidence, of the denudation of the earth's surface, and of the formation of new strata. On the other hand, upon the theory of destruction by fire, the gradual accumulation of the various elements, fossils, and plants, and the variation and modification of already formed ones, also a very slow process, and has hardly been considered to exist on even slightly more than a few millions of years. It is, therefore, clear, that ages thus meant satisfy the requirements of physical geology alone.